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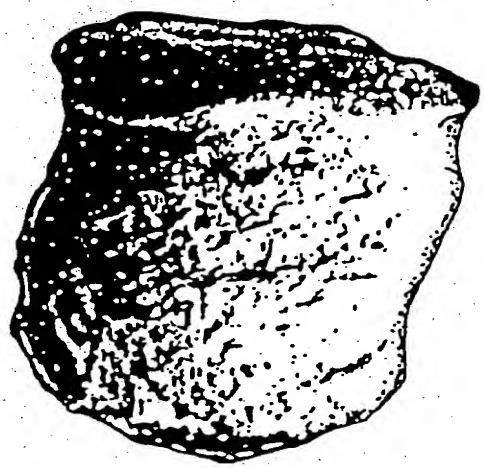
(57) Abstract

A pellet formed from a mix of two polymer materials which are non-homogenous is extruded through a die to form a highly roughened surface creating an enhanced melt fracture appearance. The extrusion is chopped into pellet form to provide a large surface area pellet to be used as a harbour for biomass in water treatment processes. Large quantities of such pellets in a filter provide a very effective filtration effect, largely because the highly roughened surface provides an enormous number of cavities within which the biomass can be retained.



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Improvements relating to Plastics Articles

One method of treating water (such as sewage) is to pass it through a filter which incorporates a large quantity of pellets or similar items so that the water passes through the cavities left between the pellets. The filtration system depends upon the presence of bacterial growth which will be provided on the pellets in the form of a biomass which acts to break down the sewage in the water. The pellets need to pack down well so as to create convoluted filtration pathways. It is also essential that the filter media should be capable of retaining the biomass on the pellets whilst water and/or air is being forced through (often with violent agitation), since the effectiveness of the filtration plant depends upon the quantity of biomass present. Cleaning of the filtration plant is often a problem and results in a loss of a substantial proportion of the biomass which then has to be regrown.

According to the present invention there is provided a pellet for use in quantity in a filter of a water treatment plant and comprising a mix of two polymer materials which are non-homogenous extruded through a die to form a highly roughened surface creating an enhanced melt fracture appearance and then chopped into pellet form to provide a large surface area pellet to be used as a harbour for biomass in water treatment processes.

Such a pellet is ideally suited for use in a filter for a water treatment plant, largely because the highly

roughened surface created by the enhanced melt fracture appearance provides an enormous number of cavities within which the biomass can be retained. The preferred forms of polymers in the polymer mix are polyolefins, preferably polypropylene or polyethylene. Styrenes, polyesters, for example PET (polyethyleneterephtalate), or polyvinylchloride are further possibilities.

Ideally additives will be incorporated into the basic polymer mix in the form of cross-linked, restructured and/or high molecular weight polyolefin material, which will help to enhance the melt fracture appearance.

In order to achieve a desired density for the pellet the polymer mix can incorporate mineral, organic or inorganic filler. It is also possible to reduce the density of the material by introducing gas into the material by injection or by incorporating a blowing agent or other basic ingredient (during formation) which will vaporise when heated or which will cause an expansion effect. By this means pellets could be formed which will tend to float on the surface of the water being treated. In other situations it may be desirable for the pellets to be of slightly greater density than the water. The pellet size will preferably lie within the range of a diameter of 2 to 8mm and a length of 2 to 8mm.

The pellets will ideally be formed by forcing them through a restricted die whose shape is such that the material will not tend to flow smoothly through the die, resulting in a non-symmetrical roughness on the pellet

surface.

Thus, according to a further aspect of this invention there is provided a method of forming pellets for use in water treatment plants, wherein a mix of two polymer materials which are non-homogenous is extruded through a die aperture under pressure, the aperture having a restricting land leading to a swell opening such that the material, after being subjected to an abrupt restriction step, is enabled to expand rapidly upon ejection from the die, the extrusion being chopped into lengths to form the pellets.

Depending upon the size of the pellets to be formed (and thus for larger sizes), the swell opening can comprise a section of the die aperture of larger cross-section than and downstream of the land. For smaller pellet sizes the exit point from the land can comprise both the swell opening and the exit point from the die. The pressure changes caused by the land and the swell opening result in substantial stresses being created in the polymer mix material leading to separation and lamination. Cooling at the exit point from the die will ideally be by cutting the pellets immediately upon extrusion and cooling in a torrent of water, or feeding the extrusion through a water cooling bath, followed by chopping into pellets. Violent stress cracking occurs on the outer surface of the pellet at the exit point from the die and rapid cooling causes this to be "frozen" in the final pellet.

Whilst certain materials would tend to be free running at high temperature through the die, the material for the

pellets of this invention tends to create a frictional effect, particularly when additives are incorporated. Preferred additives for this purpose, to be incorporated into the basic polymer mix are cross-linked, restructured and/or high molecular-weight polyolefin material, which will help to enhance the melt fracture appearance. Ideally, the base polymer mix material will constitute 80%, preferably 90% or more of the total product.

The invention further extends to a treatment plant for water (or other aqueous liquid) incorporating a container filled to a predetermined level with pellets of this invention as hereinbefore defined and provided with means for passing the liquid through the container and thus through the bed of pellets.

The invention may be performed in various ways and a preferred embodiment will now be described, by way of example, with reference to the accompanying drawings, in which:-

Figure 1 is a sectional view through part of a die used in creating pellets of this invention;

Figure 2 is a part section view of an alternative die used for this purpose; and

Figure 3 is an enlarged illustration of a pellet formed by using the die shown in Figure 1.

In forming pellets of this invention, a polypropylene or polyethylene mix of non-homogenous parts is heated to a molten state. A suitable mixture would be about 60% polyethylene together with about 40% of cross linked

polyethylene and a small amount (say ½%) of polyvinylchloride. The latter ingredient does not mix at all with the other two and also decomposes to create gas which enhances the irregular surface effect in the final product. The molten mix is forced under high pressure through an outlet section 1 of a die 2 and is subjected to rapid constriction at a land region 3. Typically, the die diameter at point A might be 5mm, reducing to 2.25mm at the land 3. A swell opening 4 is provided immediately after the land 3 (at a diameter of 2.50mm), thus enabling the material to expand again to some extent before it is finally ejected through an outlet opening 5 where further expansion occurs accompanied by rapid cooling with water. As a result of the passage of the material through the die the material is subject to substantial stresses and physical reconstruction at the regions 3 and 4 of the die and as the material is ejected from the die. This creates a highly roughened surface to the material, as can be seen from the representation of a pellet illustrated in Figure 3. The material extruded from the die is immediately chopped into pellet lengths after ejection from the die.

Figure 2 shows an alternative form of die design where the swell portion 4A is displaced to one side from the land region 3A of the die 2A. Both regions 3A and 4A have a diameter of 2.50mm, but the displacement causes somewhat similar stresses on the material, as it leaves the land region 3A, as are experienced in the die of Figure 1. For pellets of small diameter sizes the swell region and the

exit point (4 and 5) can be combined so that the exit from the die is effectively at the end of the land region 3.

A substantial quantity of pellets, such as those illustrated in Figure 3, will be held within a container having an inlet and an outlet for a aqueous liquid (for example sewage) such that the liquid can be pumped through the bed of pellets so as to achieve a high filtration effect. The pellets will have been pre-treated, if necessary, to promote bacterial growth on the pellets surface to provide a biomass which will act on organic impurities in the liquid.

CLAIMS

1. A pellet for use in quantity in a filter of a water treatment plant and comprising a mix of two polymer materials which are non-homogenous extruded through a die to form a highly roughened surface creating on enhanced melt fracture appearance and then chopped into pellet form to provide a large surface are pellet to be used as a harbour for biomass in water treatment processes.

2. A pellet according to Claim 1, wherein the polymers in the polymer mix are selected from styrenes, polyesters and polyolefins, preferably polypropylene or polyethylene.

3. A pellet according to Claim 1 or Claim 2, wherein additives are incorporated into the basic polymer mix in the form of cross-linked, restructured and/or high molecular weight material, which will help to enhance the melt fracture appearance.

4. A pellet according to Claims 3, wherein the base polymer mix material constitutes 80%, preferably 90% or more of the total product.

5. A pellet according to any one of Claims 1 to 4, wherein the polymer mix incorporates a mineral, organic or inorganic filler.

6. A pellet according to any one of Claims 1 to 5, wherein a density reduction of the material is achieved by injecting gas into the material or by incorporating a blowing agent or basic ingredient (during formation) which

will vaporise when heated or will cause an expansion effect.

7. A pellet according to any one of Claims 1 to 6, wherein the pellets are of slightly greater density than the water.

8. A pellet according to any one of Claims 1 to 6, wherein the pellets are of slightly lower density than the water.

9. A pellet according to any one of Claims 1 to 8, wherein the pellet size lies within the range of a diameter of 2 to 8 mm and a length of 2 to 8 mm.

10. A pellet according to any one of Claims 1 to 9, wherein the pellets have been formed by forcing them through a restricted die whose shape is such that the material will not tend to flow smoothly through the die, resulting in a non-symmetrical roughness on the pellet surface.

11. A method of forming pellets for use in water treatment plants, wherein a mix of two polymer materials which are non-homogenous is extruded through a die aperture under pressure, the aperture having a restricting land leading to a swell opening such that the material, after being subjected to an abrupt restriction step, is enabled to

swell opening and the exit point from the die.

14. A method according to any one of Claims 11 to 13, wherein the extrusion is cooled at the exit point from the die by cutting the pellets immediately upon extrusion and cooling in a torrent of water, or feeding the extrusion through a water cooling bath, followed by chopping into pellets.

15. A pellet as formed by the method of any of Claims 11 to 14.

16. A pellet, a method of forming pellets, or a liquid treatment plant, substantially as herein described with reference to the accompanying drawings.

17. A treatment plant for water (or other aqueous liquid) incorporating a container filled to a predetermined level with pellets in the form as defined in any of Claims 1 to 11, 15 or 16, and provided with means for passing the liquid through the container and thus through the bed of pellets.

18. Any novel combination of features of a pellet or a method of forming a pellet, or a liquid treatment plant and as described herein or illustrated in the accompanying drawings.

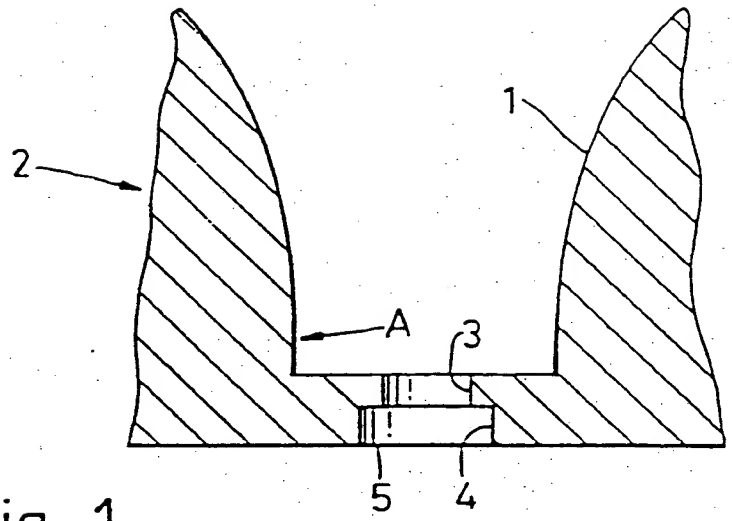
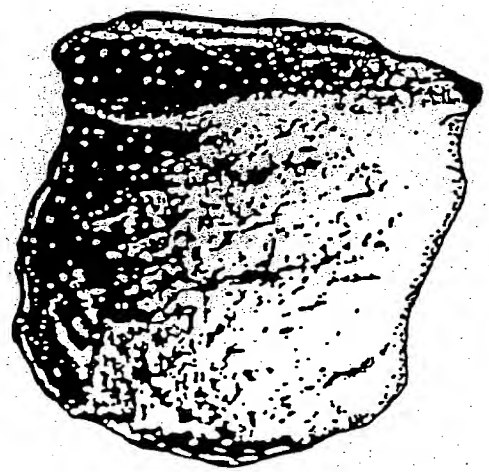


Fig. 1

Fig. 3



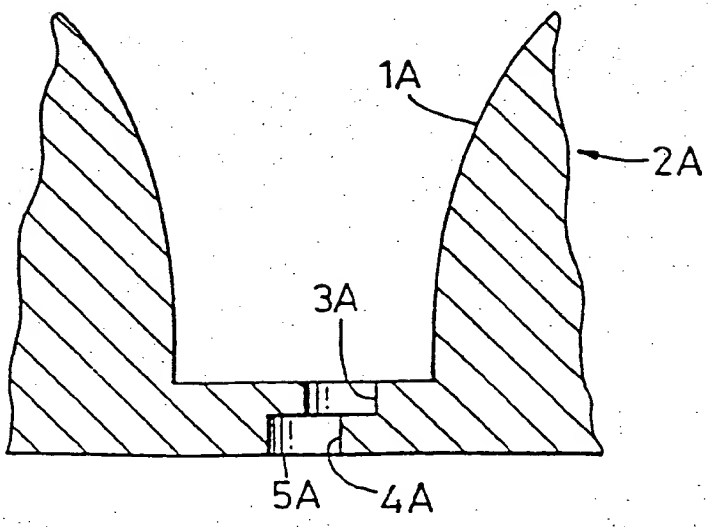


Fig. 2